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CORRECTION:—In Volume I, NO. 2, the paging should have been 25 to 48, the cover page being 25.

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INSECT FOOD OF KANSAS LIZARDS WITH NOTES ON FEEDING HABITS

By

Charles E. Burt

Most papers about North American lizards include some information concerning their food and feeding habits, but none of them, so far as known to the writer, have made it a major subject. Pritchett (1903) carried on some experiments in Texas by feeding lizards protectively colored insects. Later, Hartman (1906) published a short article on the "Food Habits of Kansas Lizards and Batrachians." Dr. Edward H. Taylor and Mr. V. H. Householder, working independently at the Kansas University Museum, each completed in 1916 a Master's Thesis dealing with Kansas lizards. In these unpublished works occasional notes on feeding habits are found, and through the courtesy of the authors and of Mr. C. D. Bunker of the Kansas University Museum, quotations, with credit, are given from them in this paper.

The present study was made at the Kansas State Agricultural College during the years 1924 to 1926, and is based upon twelve species, including all of the common lizards in the State. However, due to the availibility of material, two species, **Crotaphytus collaris** and **Cnemidophorus sexlineatus,** have been studied in greater detail than any of the others. Data have been obtained from three sources; namely, the review of the literature, feeding experiments and observations, and stomach examinations. The method of stomach analysis described by McAtee (1917) is essentially the one used by the writer. The percentages given are estimates of cubical contents.

The author wishes to express his gratitude for many helpful suggestions to Dr. Minna E. Jewell of the Kansas State Agricultural College, under whose general direction this study has been made; Dr. R. C. Smith of the Department of Entomology of the same institution has kindly helped in the analysis of stomach contents and in

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checking the scientific names of insects. Stomach examinations upon 42 specimens of lizards were made by Mr. Remington Kellogg of the Bureau of the Biological Survey, through the courtesy of Dr. W. C. Henderson, acting chief of the Bureau. In connection with the preparation of this manuscript Dr. Frank N. Blanchard of the University of Michigan has offered many helpful suggestions and corrections. To May Danheim Burt the writer is indebted for advice and aid throughout the progress of this study. To all of these the author wishes to express his grateful appreciation.

Crotaphytus collaris (Say). "Collared Lizard"

This is an abundant lizard in parts of central and eastern Kansas. Hallowell (1856) reported a stomach full of the debris of grasshoppers and beetles. Cope (1866) quoted Coues as saying that "The lizards refused all food." Pritchett (1903) reported having seen a specimen eating a dead cricket. Ruthven (1907) wrote that as far as observed the diet consists almost exclusively of insects; grasshoppers, beetles, and locusts being found in stomachs examined. Hurter (1911) quoted Fordyce as writing that the mountain boomer is a good jumper and can catch grasshoppers and other flying insects by jumping from a foot to eighteen inches in the air after them. Ellis and Henderson (1913) stated that the food consists of insects, small toads and lizards, often small individuals of their own species, and they will also eat flower heads. Ditmars (1915) regarded these lizards as very ferocious, stating that they will greedily consume swifts, horned toads, and even some snakes. Cowles (1920) reported the finding of a race-runner, **Cnemidophorus tigris tigris,** in the stomach of a large specimen. Taylor (1916) found the remains of two young collard lizards in the stomach of a large male, an instance of true cannibalism.

In the author's feeding experiments the animals were placed in a glass aquarium which had a removable screen top. Food was introduced and reactions observed. Sweepings taken from plants, mostly alfalfa and blue grass, were put into the cage and note taken of the number and kinds of insects selected by the various lizards.

Cabbage butterflies (**Pieris rapae** L.), large grass-

hoppers, walking sticks (**Diapheromera velii** Walsh), field crickets, (**Gryllus assimilis luctuosa** Ser.), jumping spiders (**Attidae**), a large ground centipede (**Scolopendra heros** Gir.), skipper butterflies (**Hesperiidae**), bee flies (**Bombyliidae**), house flies (**Musca domestica** L.), and certain small insects which were obtained by lapping the tongue over the sand in the bottom of the cage were devoured. Dingy cutworm moths (**Feltia subgothica** Haw.) and mayflies (**Ephemerida**) were eaten readily, and many could often be fed consecutively to one individual. A large dragon fly was seized by the wing and as it fluttered the lizard slowly engulfed it. A hawk moth (**Celerio lineata** Fabr.) was caught by the leg. As it struggled the lizard let go of the leg and took it by the wing, holding to it tenaciously, interrupting only with short snaps which brought the moth's head to the jaws. Thus the insect was subdued and consumed. Once a collared lizard was observed to swallow a medium sized skink, **Eumeces septentrionalis** (Baird).

The effect of lowered temperature upon the feeding of this lizard was observed one cool evening while feeding it a cricket. Many inaccurate dives were made in an effort to catch the insect which remained in the cage until the next day, then, after the lizard had been warmed by the morning sun, the prey was eaten.

The accompanying table is based upon an examination of sixteen stomachs. The analysis of a seventeenth stomach, which contained a single round pebble, is not included.

Table of Stomach Contents

ORTHOPTERA

Grasshoppers: 4 Locustidae; 1 **Hesperotettix brevipennis pratensis** (Scud.): 1 **Hippiscus sp.**; 1 Tryxalinidae; 1 **Chortophaga viridifascitata** (DeGreer); 3 **Arphia sp.**; 1 **Dissosterira carolina (L.)**; 3 **Melanoplus keeleri luridus** (Dodge); 6 **Melanoplus mexicanus atlanis** (Riley); 2 **Melanoplus femur-rubrum** (DeG.); 1 **Melanoplus bivittatus (Say)**; 4 Oedipodinae.

Crickets: 5 **Gryllus assimilis luctuosa** Serville
Katydid: 1 **Microcentrum** sp.....88.3%

LEPIDOPTERA

Moths: 1 adult; 1 caterpillar; 1 pupa (army or cutworm) 6.6%

COLEOPTERA
Beetles: 1 **Melanotus sp.**; 1 Carabidae..... 1.0%

ARACHNIDA
Spiders: 1 Araneida; 1 Attidae; 1 Argiopoidea 4.1%
The food of this species consists, therefore, essentially of the larger insects, particularly grasshoppers.

Holbrookia maculata maculata (Girard).
"Holbrook's Spotted Lizard"

Hartman (1906) stated that "This lizard lives upon grasshoppers and small beetles. Sixty specimens, which were kept for a few months, thrived upon grasshopper nymphs. Grasshoppers which showed no signs of life when put into the cage were never touched, but others were grabbed and eaten."

The author has made only a few feeding observations upon these beautiful creatures. One ate a number of small insects rapidly. The tarnished plant bug (**Lygus pratensis** L.) was eaten after a short chase and swallowed in one gulp.

The analysis of four stomachs has furnished the data for the table below.

Table of Stomach Contents

ORTHOPTERA
Grasshoppers: 3 Locustidae 43.0%

LEPIDOPTERA
Moth: 1 caterpillar.....7.5%

COLEOPTERA
Beetles: 1 **Graphops sp.**; 1 **Haltica sp.**..... 2.0%

HEMIPTERA
Bugs: 1 **Galgupha sp.**; 37 **Blissus leucopterus** (Say); 3 **Corizus lateralis** (Say); 1 **Macrocephalus prehensilis** (Fabr.).....27.5%

HYMENOPTERA
Bees: 3 **Andrena sp.**; 2 **Halictus sp.**
Ichneumon fly; 1 Ichneumonidae..... 9.5%

DIPTERA
Fly: 1 Tachinidae 1.5%

ARACHNIDA
Spiders: 1 Araneida; 2 Attidae 8.0%

VEGETABLE MATTER
Seeds of Gromwell plant: 2 **Lithospermum sp**..1.0%

The table shows **Holbrookia maculata maculata** to be a voracious feeder upon small insects, and indicates relatively high percentages of Orthoptera and Hemiptera as the food of the species. The finding of 28 chinch bugs and twelve other small insects in the stomach of a specimen collected in a wheat field in Ottawa County suggests that the spotted lizard may be of considerable economic importance in some sections.

Sceloporus undulatus thayerii (Baird and Girard).
"Yellow-banded swift."

Shufeldt (1885) reported keeping this subspecies for two months without food. Ruthven (1907) stated that the stomachs of the specimens examined contained a robber fly, the remains of a small beetle and a few ants; a specimen on the plains had eaten a grasshopper, a few beetles, ants, and one or two fragments of vegetable matter. This writer noticed occasional fragments of vegetable matter in the stomach contents of lizards. It is probable that they were part of the intestinal content of insects which were eaten, and had been set free in the stomach during the process of digestion, rather than having been eaten voluntarily by the lizard. This seems especially probable of lizards which eat grasshoppers.

In experiments the yellow-banded swift displayed a great degree of fondness for a variety of insects, such as houseflies, lacewings (Chrysopidae), tarnished plant bugs, leaf hoppers (Cicadellidae), tree-hoppers (Membracidae), green measuring worms (Geometridae), dingy cutworm moths, corn earworm moths (**Heliothis obsoleta** Fabr.), and green stink bugs (Pentatomidae). Small grasshoppers were readily eaten, while large grasshoppers were sometimes attacked, but not eaten. Once when a large grasshopper was introduced, the swift opened its mouth wide and stood motionless while the insect crawled over the sand in the bottom of the cage. As the grasshopper approached, the lizard crouched and moved its tongue. Then suddenly it darted forward and closed its mouth over the head of the grasshopper. After the insect was killed the lizard left it laying upon the sand. Larger insects, such as corn earworm moths, were eaten

much slower than the smaller species. Lady beetles (Coccinellidae) were usually rejected, but on a single occasion one was eaten. Honey bees (**Apis mellifica** L.) were always refused. A medium sized male was stung by one of these bees and died a few minutes afterward, following a series of rapid undulations of the body.

The stomach analysis of five specimens is shown in the table below:

Table of Stomach Contents

ORTHOPTERA
Grasshoppers: 6 Locustidae
Crickets: 2 **Gryllus sp.** **35.6%**

LEPIDOPTERA
Moth: 1 adult 1.6%

COLEOPTERA
Beetles: 1 **Disonycha caroliniana (Fbr.)** 1 **Zygogramma suturalis casta** Rogers; 1 **Ceutorhynchus sp.**; 1 **Cantharis bilineatus** Say; 1 **Harpalus sp.**; 1 **Discoderus sp.**; 1 **Lacon rectangularis** (Say); 1 **Melanotus sp.** 30.6%

HEMIPTERA
Bugs: 2 Hemiptera; 1 **Galgupha sp.** 4.4%

HOMOPTERA
Frog hoppers: 4 Cercopidae 3.6%

HYMENOPTERA
Ants: 1 **Formica sp.**; 1 **Pheidole sp.**; 1 **Tapinoma sessile** Say; 30 **Crematogaster sp.**; 79 **Lasius sp.**
Wasps: 2 **Chrysis sp.**
Bees: 3 **Halictus** sp. 11.8%

TRICOPTERA
Caddice fly: 1 nymph 0.2%

ARACHNIDA
Spider: 1 Attidae 0.2%

VEGETABLE MATTER
Seeds of Gromwell plant: 6 **Lithospermum sp.** 12.0%

The above table indicates that the yellow-banded swift feeds upon a large variety of insects, particularly beetles, ants and grasshoppers. A feature of interest not brought out in the table is the fact that over one hundred ants were found in the stomach of a single individual from McPherson County. The author's only rec-

ord of vegetable matter being consumed by this species is that of a stomach which contained six seeds of the Gromwell plant.

Sceloporus undulatus undulatus (Latreille).
"Pine-lizard"

This lizard is common in southeastern United States, and is distributed as far north as Indiana. Kansas is on the western edge of its distribution, and on the eastern edge of that of the related subspecies, **S. undulatus thayerii,** which the writer has found to be distributed over a greater area in the state.

Holbrook (1842) stated that its food is insects, chiefly those found under decaying wood. Hay (1892) wrote that their food consists of flies, ants, small spiders, and the like. Brimley (1905) listed it as having been known to eat house-flies, young grasshoppers, ground beetles, and leaf-hoppers. Allard (1909) found that this lizard is very fond of grubs and all kinds of insects, grasshoppers, etc. According to Hurter (1911) the lizard in endeavoring to catch flies often misses its aim, though the insects are within easy reach. The author has found the same thing to be true of **S. undulatus thayerii.** Boulenger (1914) stated that its food in the wild state is said to consist of only such insects as are found under decayed wood. Ditmars (1915) specified that for captive specimens the food should be mealworms and other soft bodied insects. Taylor (1916) found that the food consists chiefly of grasshopper nymphs, ants and small beetles. This agrees very well with the results shown in the table of stomach analysis which the author presents here under **S. undulatus thayerii.**

Thus, the pine-lizard is shown to be a feeder upon insects and spiders, and no doubt because of its size chooses only the smaller ones.

Phrynosoma cornutum (Harlan).
"Texas Horned Lizard"

This is the common horned lizard of Kansas. Pritchett (1903) did not observe it eating anything but ants. Hartman (1906) found by stomach examinations that it eats a great number of small beetles. Ruthven

(1907) found that an examination of several stomachs showed that the principal food is insects, ants greatly predominating. Beetles were present in small numbers, and a few leaves of some weed which may have been taken in accidently with the food. Winton (1914) included isopods in the list of stomach contents. Ditmars (1915) gave directions for keeping these creatures as indoor pets: "A flood of sunlight each day is absolutely necessary to keep them in good health and feeding. Water should be given them in very shallow dishes. Meal worms are a very good food; also, ants, small, soft bodied grubs, roaches, grasshoppers and crickets. They will not eat earthworms." Hyslop (1916) listed horned lizards as natural enemies of wire worms and their beetles **(Elateridae)**. Winton (1916) found that in feeding, small insects are clearly preferred; but sometimes a venturesome individual will swallow a large grasshopper or even a snail. He also describes the eating of a "large brown May beetle" by one of these lizards. The same author (1917) stated that the horned lizard is very sensitive to the stings of large agricultural ants which form its principal food.

In experiments, honey bees, corn earworm moths, lacewings, houseflies, little fruit flies (**Drosophila melanogaster** Meigen), mosquitoes (Culicidae), winged ants, tarnished plant bugs, solitary bees, small grasshopper nymphs, small crickets, and dingy cutworm moths, were all eaten readily. The absence of large insects from the list is noteworthy. The mouth of the horned lizard is not capacious. The writer found that this lizard would not feed normally on cool or cloudy days, even when other species of the Iguanidae would eat readily. On such days these creatures would, however, swallow small insects which were placed in their mouths.

Some of the writer's specimens which were kept in the sun during the forenoon, ate readily from insect sweepings, rarely chasing their prey. Often when insects happened near, they remained relatively motionless, merely thrusting their little pink tongues outward, usually to return with the prey.

Householder (1916) stated that the stomach of one specimen was found to contain a number of small insects: 1 scarred snout beetle (Otiorhynchidae), 2 leaf-beetles (Chrysomelidae), 1 leaf-hopper (Membracidae), numer-

ous beetles, and approximately 1200 ants.

From the above discussion it would appear that the natural food of the horned lizard is chiefly ants and other small insects.

Ophisaurus ventralis (Linne).
"Glass-snake"

Cope (1900) wrote that this species is a rapacious feeder, feeds readily in confinement, and takes insects from the hand. Brimley (1905) stated that it has been observed to eat katydids, large bird grasshoppers (**Schistocera americana**), and large butterflies, such as the swallowtails Hartman (1906) found that a specimen collected at Lawrence contained three large grasshoppers, one cricket, and one large caterpillar. Boulenger (1914) wrote of the glass-snake of Europe, **Ophisaurus apus** Linne, as feeding principally upon mice. Ditmars (1915) listed the food of **O. ventralis** as consisting of earth worms, slugs, the larvae of insects and sometimes the eggs of ground nesting birds. Taylor (1916) found that a specimen taken in August under a wheat shock contained over twenty insects, mostly beetles and grasshoppers. One of the writer's specimens ate a grasshopper and a cricket.

Cope (1900) listed the contents of one stomach as consisting of 3 ground spiders, 1 grasshopper cricket, 1 cockroach, 1 young snail, 1 beetle larva, and 1 Lepidoptera.

From the above discussion it seems apparent that the glass-snake feeds chiefly on the larger insects.

Cnemidophorus sexlineatus (Linne).
"Six-lined Racerunner"

This lizard has a very wide distribution over the eastern and central states, and the author has records of its occurrence in 53 of the 105 Kansas counties. Since it lives under a variety of conditions, there is certainly considerable variation in its food.

Holbrook (1842) wrote that they feed upon insects, and generally seek their food toward the close of the day, when they may be seen in cornfields far from their usual

retreat, and not infrequently male and female are seen in company. Cope (1866) published a report from Ft. Whipple, Colorado, that they came into the tents at all times, silently and furtively looking for flies. Hartman (1906) stated that it can run with such speed that no insect, even the wary tiger beetle, can escape. It eats cockroaches and tiger beetles. Ruthven (1907) found ants and spiders in stomachs examined. Ditmars (1915) noted that "Adults are not adverse to feasting on eggs of small birds that build their nests on the ground," but the writer, after considering the size of the lizard's mouth, believes that only very small eggs, if any, would be eaten. Taylor (1916) made the following observations: "A large male specimen was seen to chase a grasshopper (**Melanoplus differentialis**) for a number of feet, each time stalking the insect as a cat would a bird, only to have it jump and fly some distance. This was repeated three times. Finally the lizard climbed to the top of a weed, jumped from one of the branches, and fell to the ground with the struggling insect. Another specimen was seen to jump for a grasshopper nymph which flew about a foot from the ground, but fail to catch it."

The many specimens used in the writer's experiments, demonstrated that flesh flies (Sarcophagidae), leaf-hoppers, tree-hoppers, skipper butterflies, harvestmen (Phlangidae), lightning bugs (Lampyridae), tarnished plant-bugs, dingy cut-worm moths, striped cucumber beetles (**Diabrotica vittata** Fabr.), grasshoppers, tree-crickets, houseflies, measuring worms, lace-wings, green stink bugs, alfalfa butterflies (**Eurymus eurytheme** Boisd.), and the corn earworm moth, were eaten with relish. Big butterflies, such as the swallow-tails (Papilio) were often killed, but not eaten. Ground beetles were eaten when the elytra were removed, showing the lizard's preference for softer bodied insects. A hairy caterpillar was introduced and seen by the lizard which came close to it. The fuzz tickled the lizard's snout, so it stopped and rubbed its nose in the sand, then made another attack upon the larva. The process was repeated several times. Occasionally the reptile shook the worm or rubbed it in the sand, and much fuzz was removed. Finally, when all the hair was gone, the lizard swallowed the caterpillar. A large cricket was pulled to pieces and eaten part by part. On one occasion two lizards fought over an alfalfa bloom until it was consum-

ed, and they often fought over insects. Lady beetles were watched intently, but if taken into the mouth, were always rejected.

Often this animal does not detect undesirable food until it is taken into the mouth. Such food is quickly ejected, and the lips are then usually wiped on the ground, the lizards displaying great discomfort. Members of this species are exceedingly voracious feeders, both in natural habitats and in captivity. On warm days a considerable number of small insects were eaten in a very short time, and the listing of the dozens of insects eaten from insect sweepings which were introduced is not attempted.

Data obtained from analyses of fifteen stomachs are given in the table below.

ORTHOPTERA

Grasshoppers: 6 **Melanoplus sp.**; 1 **Melanoplus differentialis** (Uhler); 5 Locustidae; 1 Tettigidae; 1 **Nomotettix sp.**; 1 Oedipodinae.
Cricket: 1 Gryllidae.
Katydid: 1 Tettigoniidae 41.5%

LEPIDOPTERA

Moths: 9 adults; 2 pupae; 11 caterpillars; 1 Geomitridae 19.9%

COLEOPTERA

Beetles: 1 **Agonoderus obliqulus** Casey; 1 **Arma sp.**; 4 **Sitona hispidulus** (Fabr.); 1 **Baris sp.** 2.5%

HEMIPTERA

Bugs: 1 Hemiptera; 1 **Corizus hyalinus** (Fabr.) 2.2%

HYMENOPTERA

Ants: 1 **Ponera sp.**; 2 **Crematogaster sp.**; 1 **Camponotus sp.**; 1 **Formica sp.**
Chalcid fly: 1 **Chalcis sp.**
Ichneumon fly: 1 **Sigalphus sp.**..... 1.9%

DIPTERA

Flies: 3 **Tachinidae**..... 0.5%

ARACHNIDA

Spiders: 10 Araneida; 9 Attidae; 3 Lycosidae 24.5%

MOLLUSCA
Land snails: 5 Pupidae; 1 **Polygyra sp.**; 1 Gastropoda 7.0%

The above records indicate that the race-runner is fond of spiders and many small insects, especially grasshoppers and Lepidoptera. The finding of a total of seven land snails in three of the fifteen stomachs examined suggests that snails may be a substantial part of the lizard's natural menu.

Leiolopisma laterale (Say). "Ground-lizard"

This lizard is not widely distributed in Kansas. Holbrook (1842) called attention to the fact that they emerge from their retreats in thick forests of oak and hickory after sunset in search of small insects and worms. The writer has also observed these animals displaying great activity in the day time. Ditmars (1915) found that they thrive in captivity if provided with an abundance of good food, ants and their larvae, and grubs of the smaller wood-boring beetles. Taylor (1916) stated that "They feed readily in the sunlight. One was observed making a large meal from flies swarming about the base of a tree that was leaking sap. Several captive specimens took flies from one's fingers with little hesitancy, and also ate ants."

The results of the analysis of one stomach are given in the following table.

Table of Stomach Contents.

COLEOPTERA
Beetle: 1 **Metachroma sp.** 12.0%

HYMENOPTERA
Ant: 1 **Myrimica sp.** 48.0%

DIPTERA
Flies: 3 Bibionidae 36.0%

ARACHNIDA
Red mite: 1 Acarina 4.0%

Eumeces fasciatus (Linne). "Five-lined Skink."

Brimley (1905) stated that this species has been observed to eat houseflies, butterflies, small Carabid beetles, earth-worms, cockroaches, and large smooth cater-

pillars, but bright colored butterflies were not liked.

The stomachs of two specimens were examined and found to contain the items listed in the table below.

Table of Stomach Contents.

ORTHOPTERA

Grasshopper: 1 Locustidae.
Wood cockroach: **Parcoblatta sp.**
Cricket: **Gryllus pennsylvanicus** Burm..... 69.0%

ARACHNIDA

Spiders: 1 Attidae; 1 Lycosidae..... 31.0%

Eumeces guttulatus (Hallowell). "Blue Spotted Skink"

Hartman (1906) listed the contents of a stomach as "A fly, a spider, two leaf-hoppers, and a cricket. Two specimens kept in captivity ate flies and grasshoppers." Taylor (1916) stated that "They were voracious feeders and undisturbed by one's presence. They were very crafty in their approach if a fly showed movement. They would crouch, then crawl very slowly to the fly, and finally, with a sudden jerk of the head, would grab the insect and swallow it after a series of chewing movements. They paid no attention to dead or motionless insects."

Data held by the writer tends to indicate that **E. guttulatus** is the young of **E. obsoletus.**

Eumeces obsoletus (Baird and Girard).
"Sonoran Skink"

Hartman (1906) described these skinks as "Large, powerful lizards which will attack animals as large as themselves. A specimen was put into a cage with a young collared lizard. In a few days the cage was opened and nothing but the mutilated bones of the collared lizard were found. A specimen examined had eaten large grasshoppers and crickets, and a large ground spider."

This species remains covered with earth or sand a great deal of the time, but when it is in the open it feeds readily and voraciously. Caterpillars, honey bees, corn earworm moths, dingy cutworm moths, large black crick-

ets, grasshoppers, cabbage butterflies, houseflies, and little green measuring worms were eaten with relish. Pieces of beef and ground beetles with their elytra removed were swallowed when forcibly introduced into the mouth. Adult ground beetles were taken into the mouth, crushed and ejected, and lady beetles were always rejected.

The examination of three stomachs of Sonoran skinks has given the data for the following table.

Table of Stomach Contents.

ORTHOPTERA
Grasshoppers: 1 Locustidae; 1 **Melanoplus sp.**
Katydid: 1 Tettigoniidae 42.0%

LEPIDOPTERA
Moths: 3 caterpillars 57.0%

ARACHNIDA
Spider: 1 Araneida 1.0%

Eumeces septentrionalis (Baird).
"Northern Skink"

This lizard, like other small skinks, is an active feeder upon small insects. Captive specimens have been observed to eat measuring worms, leaf-hoppers, tree-hoppers, green aphids, lace-wings, small grasshoppers, and other forms.

DISCUSSION.

Kansas lizards are chiefly diurnal, predacious, insectivorus animals. They appear to have an optimum feeding temperature which is usually reached on warm days in summer. After a cool night lizards are very inactive and must be warmed by the sun before they gain activity enough to catch living food. If they are not warmed, they do not feed. This has been observed by Newman and Patterson (1909) in the study of **Sceloporus spinosus floridanus** (Baird), a spiny swift of Texas. "In the day, the first want of the lizard is warmth. It will bask in the sun until it is warm, even before it feeds." The author has found that on cool and cloudy days lizards are usually, and always relatively, inactive, while on warmer days many come from their retreats and

search for food.

Pearse (1926) stated that "The distribution of animals often has direct relation to the availability of food, and particular foods are the leading factor in the lives of many animals." This is true in the case of lizards to a large extent. They are found in habitats where an abundance of insect and arachnid food is available.

Only a few records tell of lizards eating dead insects by selection. Pritchett's report (1903) has been cited. The author's experiment, using the same insect and the same species of lizard, was unsuccessful when the insect was not moved. Lizards apparently depend on the movement of their prey for its detection. They often watch their victims until movement is shown, and then make a swift dart forward. During this dart the lizard's mouth is opened and the movement is terminated by the closure of its jaws over the food.

The interrelations of the species of Kansas lizards, in regard to their food and feeding habits, may be discussed under three heads, namely, (1) the size, (2) habitat, and (3) family of the lizard.

The large lizards, **Crotaphytus collaris, Ophisaurus ventralis** and **Eumeces obsoletus** all eat the larger available insects and arachnids, especially adult grasshoppers, crickets, spiders, moths and butterflies, and also larvae or nymphs of the same. These species are not as fast or as accurate in securing their prey as the smaller ones. As a rule smaller insects are apt to be unnoticed by the larger lizards. Such insects may fly all around the lizards, and crawl all over them without being eaten. The glass-snake probably eats small rodents, but such would hardly be expected of the collared lizard and Sonoran skink. In contrast to these the smaller species of lizards, **Holbrookia maculata maculata, Sceloporus undulatus thayerii, S. undulatus undulatus, Phrynosoma cornutum, Cnemidophorus sexlineatus, Leiolopisma laterale, Eumeces fasciatus, E. guttulatus,** and **E. septentrionalis,** all notice and eat large numbers of the smaller insects, such as leaf and tree-hoppers, tree crickets, lacewings, ants, smaller species of grasshoppers, and nymphs of the larger forms. A larger insect may also be eaten after it has been killed and torn to pieces. The smaller species of lizards are generally accurate when darting for their prey, and are usually active while feeding.

The grouping of lizards, based on their characteristic habitats, is a difficult problem because their ranges often overlap to a great extent, both in the state and in local areas. However, certain types of habitats do come to be associated with particular species. In the rolling prairie country of central and western Kansas, with its rocky ledges, many sandy stretches, and intermittent growth of grasses, the lizards, **Holbrookia maculata maculata, Sceloporus undulatus thayerii Cnemidophorus sexlineatus, Phrynosoma cornutum,** and **Eumeces obsoletus** are often found. These have available to them the prairie species of insects and arachnids, which, like themselves, are able to tolerate the condition of relative dryness presented by their habitat. In parts of central and eastern Kansas numerous limestone ledges and many hills are found. It is here that the most species of Kansas lizards occur. Characteristic forms are **Crotaphytus collaris, Ophisaurus ventralis, Eumeces obsoletus, E. guttulatus, E. septentrionalis,** and **Cnemidophorus sexlineatus.** In eastern Kansas are many wooded streams. In this habitat there is a relatively high moisture content in the surface soil. Here occur, typically, **Sceloporus undulatus undulatus. Eumeces faciatus, Ophisaurus ventralis, Cnemidophorus sexlineatus,** and **Leiolopisma laterale.** Thus Kansas presents a faunal gradient, both in the distribution of its lizards and their prey, varying from a moist wooded habitat in the east to a dry, open prairie habitat in the west.

The family Iguanidae includes a varied group of lizards, both in their appearance and feeding habits. As a rule they are not as agile as other groups. **Crotaphytus** and **Phrynosoma** are relatively awkward, whereas, **Sceloporus** and **Holbrookia** are rather graceful in their feeding movements. Unlike other genera, **Phrynosoma** sometimes remains stationary and uses its tongue to secure food, much as a toad does. Members of the family Scincidae and the glass-snake (Anguidae) have a tendency to be snake-like in their movements, due to their serpentine form and the reduction or loss of their legs. They often steal slyly upon their prey. The race-runner (Teiidae) is perhaps the most active of all Kansas lizards. It darts upon many victims in quick succession when at the height of its feeding activity.

A summary of the analyses of the stomach contents

of 49 lizards reported in this paper is presented in the following table:

Orthoptera	51.92%
Lepidoptera	11.65%
Arachnida	9.35%
Hymenoptera	8.90%
Coleoptera	6.00%
Diptera	4.76%
Hemiptera	4.34%
Vegetable matter	1.73%
Mollusca	0.87%
Homoptera	0.45%
Trichoptera	0.03%

Since size and not numbers of the prey of Kansas lizards is the basis of the percentage in the above table, it appears that the most subsistence was obtained from Orthoptera and Lepidoptera, two large groups of insect pests which are very abundant in Kansas.

Many people, whose sentiments rightly favor birds and toads, do not as a rule, realize the true value of their lizard friends. In the case of insect outbreaks, lizards, if present in the area, may usually be expected to eat the common form, thereby doing their share toward limiting its destructiveness. At present the lizards of Kansas are usually located in isolated areas where the minimum of benefit is derived from their feeding. This condition is due, in part at least, to the blind incessant war that much of mankind makes upon all reptilian life. Recent collecting indicates that certain lizards, notably the glass-snake, are becoming rarer in Kansas, and if more toleration is not given them, they face ultimate extinction in places where they are now abundant.

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PROCEEDINGS OF THE KANSAS ENTOMOLOGICAL SOCIETY

Minutes of the Fourth Annual Meeting.

President Knaus called the meeting to order at 10:30 a. m. on April 14, 1928, in Science Hall, Wichita University, Wichita, Kansas. The minutes of the last annual meeting were read and approved.

A motion was made that the Society give a vote of thanks to W. Knaus and J. W. McColloch for their work on the Journal of the Kansas Entomological Society. Motion carried.

Motion made that a telegram of greetings and well wishes be sent to J. W. McColloch for speedy recovery from his illness. Motion carried. A collection was taken to defray the expense of the telegram.

A motion made and carried that the surplus money above the cost of the telegram be placed in the treasury ($1.00).

Report of Committees.

Publication committee reported progress. Committee continued.
Committee on wild life preserves reported no progress. Committee continued.
Radio committee made no report. Committee discharged since there was no further need of the committee.
Committee on Kansas check list of insects reported progress in the publication of the Journal of the Kansas Entomological Society. It was suggested that contributions from all those interested send in material to the publication committee.

A committee on constitution was appointed by President Knaus during the year—J. W. McColloch, P. B. Lawson, and R. L. Parker.

The constitution was read by the secretary and was adopted. The committee was discharged with thanks.

The report of the secretary, who has had to function as treasurer, was read and accepted.

The secretary reported that there are at present 115 subscribers to the Journal of the Kansas Entomological Society.

The chairman appointed the committee on nominations as follows: Hazel Branch, R. C. Smith and R. H. Painter.

NEW BUSINESS

Since a clause in the constitution is to the effect that the Society affiliate itself with the Kansas Academy of Science, a motion was made and carried that the secretary announce this fact to the Academy, which was in session at that time. It was done by the secretary.

A motion made and carried that the fossil beds near Abilene be included in the wild life preserve and that the wild life committee be empowered to act. The chairman appointed a third member to this committee—P. B. Lawson. The other members of this committee are W. Knaus and J. W. McColloch.

A motion was made and carried, authorizing the secretary to publish a notice of a field meeting to be held at the fossil beds, this meeting to be held in May in connection with the visit of Dr. R. J. Tillyard of Australia.

A telegram was received from H. B. Hungerford,

regretting inability to attend the entomology meeting.

The chairman appointed the following committee on insignia and motto for the Society: Kathleen Doering, P. M. Gilmer and R. L. Parker. If an agreement can be made it will be published in July or October.

Motion made and carried that the matter of exchanges be left for the decision of the publication committee.

The nomination committee reported the following names for the officers of the year 1928-1929, and they were so voted into office:

President—P. M. Gilmer
Vice-President—Kathleen Doering
Secretary-Treasurer—R. L. Parker.

The remainder of the meeting was given over to the reading of papers and informal discussion. W. Knaus read a paper "Rare Coleoptera from the Sandhill Region of Medora, Kansas". P. M. Gilmer discussed the relation of Mutilids and their activities and other insect forms in sand dune areas. R. H. Painter discussed the collection of Bombyliidae and Asilidae, which was made on July 3 and 4, 1927, in the Medora region. W. Knaus discussed the probability that Fabricius never saw a specimen of what is now considered **Cicindela violacae** Fab. The Cicindelid described by Fabricius in 1801 was from the Carolinas, but the **Cicindela violacea** of North American collections are found in Kansas, Nebraska, and Iowa, and doubtfully in Mississippi. The **violacae** (of Fabricius) was an Atlantic coast region variety probably of **Cicindela scutellaris** Say. or a form of **C. sexguttata** (Fab.) not yet recognized in the United States, while the Cicindelid that passes for **violacea** is really undescribed.

Adjournment. R. L. PARKER, Secretary.

FIELD MEETING AT INSECT FOSSIL BED.

A field meeting of the Kansas Entomological Society was held on Sunday, May 20, 1928, at the insect fossil bed in Dickinson County. This meeting was of particular interest because of the presence of Dr. R. J. Tillyard of Australia, an authority on fossil insects. Doctor Tillyard has described and identified many of the fossil insects taken from this bed in the past. It is from these fossil insects and those which he has found in Australia that he has evolved his theory of wing venation, as well as the descent of the orders of Insecta.

Although the weather was threatening, there were about 30 people present from Lawrence, Manhattan, and Kansas City, and many participated in the work of making little stones out of big ones. A few good finds were made which pleased Doctor Tillyard.

CONSTITUTION AND BY-LAWS OF THE KANSAS ENTOMOLOGICAL SOCIETY

NAME

Article I. The name of this Society shall be the Kansas Entomological Society. This Society will be affiliated with the Kansas Academy of Science, without dues to that society.

OBJECT.

Article II. The object of this society shall be the promotion of the interests of entomology in Kansas.

MEMBERSHIP.

Article III. Membership in this society shall consist of persons interested in entomology.

OFFICERS.

Article IV. The officers of this society shall be the President, Vice-President and Secretary-Treasurer. These officers shall constitute the Executive Committee of the society, and shall be elected by the society at the annual meeting, from nominations made by a committee appointed by the chair, or nominations from the floor.

MEETINGS.

Article V. There shall be a stated annual meeting held in accordance with the action of the society at the preceding annual meeting. Special meetings and field meetings may be held at the call of the President, and the Secretary-Treasurer shall give full advertisement of all such meetings.

PUBLICATION

Article VI. The publication of the society shall be the Journal of the Kansas Entomological Society. This journal shall be edited by a publication committee consisting of five members appointed annually by the president; three of these to retire one year and two to be retired the following year. The editor shall

be elected by the members of the publication committee. All members not in arrears shall receive the journal as issued by the Kansas Entomological Society.

DUES.

Article VII. The annual dues for members shall be $1.50. The executive committee may determine the proportion of the annual dues of members to be devoted to the expense of the publication of the Journal of the Kansas Entomological Society, but in no case shall this amount be less than three-fourths of the total.

AMENDMENT.

Article VIII. This constitution may be amended by two-thirds of the members present and voting at a regular scheduled business session of an annual meeting, or by two-thirds of the members voting in a mail ballot, provided that, in either case, notice of the proposed amendment shall have been mailed to each member of the society at least 60 days before the date of the vote.

BY-LAWS

1. The annual meeting of the society shall be held whenever practicable at the same time and place as the annual meeting of the Kansas Academy of Science. The exact time of the meeting shall be left to the executive committee.
2. Order of business at the annual meeting shall be as follows:

1. Minutes of the last annual meeting shall be read.
2. Reports of officers and standing committees.
3. Appointment of committees.
4. Old business.
5. New business.
6. Papers, discussions and exhibits.
7. Final business.

Report of special committees.
Report of committee on resolutions.
Report of committee on membership.
Report of committee on nominations.
Report of other committees.
Election of officers.
Unfinished business.
Fixing the time and place of the next meeting.